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FINAL REGULATORY EVALUATION

DOOR LATCH TEST PROCEDURES
FMVSS No. 206

Office of Regulatory Analysis and Evaluation
National Center for Statistics and Analysis
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People Saving People

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Executive Summary

This Final Rule adds and updates test procedures for door latches. Only one of these, a new sliding door test procedure for FMVSS No. 206 is believed to add costs to vehicles and provide quantifiable benefits for consumers. The estimated impacts of the sliding door test procedure are:

Costs
Of the vehicles with sliding doors (mini-vans and large vans) there were almost 1.4 million vans sold in 2003 that had a little more than 2 million sliding doors.
An estimated 660,000 vans (48%) with 1.2 million doors (60%) need a second latch to comply.

The incremental cost of adding a second latch is estimated to average $7.00 per door.

Total costs are estimated at $8.4 million (in 2003 economics)

Benefits
The average annual ejections through sliding doors from 1995-2003 resulted in 20 fatalities and 30 injuries. When an occupant is retained in a vehicle and the ejection is eliminated, it does not necessarily mean that the occupant escapes injury. When all vehicles with sliding doors meet this proposal, annually an estimated 7 fatalities and 4 occupants with serious to severe injuries would be reduced in severity to minor injuries (AIS 1) as a result of remaining inside the vehicle.

Cost per Equivalent Life Saved
The cost per equivalent life saved is
$1.35 million at a 3 percent discount rate or
$1.71 million at a 7 percent discount rate.

Net Benefits
$13.3 million at a 3 percent discount rate or
$8.8 million at a 7 percent discount rate.

I. Introduction

For many years the agency has been analyzing a variety of test procedures relating to door locks and door in frame tests (related to FMVSS No. 206) in an attempt to find tests that correlate well with door openings in crash data. For the most part these attempts to correlate test results from different test procedures with crash data have been unsuccessful. We believe that part of the reason that correlations are unsuccessful is that vehicles get into so many different types of crashes at different speeds and angles, including rollovers, and doors open for a variety of reasons.

Through its harmonization efforts, the agency has been working with other countries to harmonize standards relating to door locks to the extent possible. Transport Canada developed a test procedure for sliding doors[1], which the agency and other countries around the world have been considering for inclusion in their requirements. The agency previously had a requirement, without a test procedure, for door locks on sliding doors for some time. Two other new test procedures that are part of the harmonized effort include: adding a secondary latch requirements for doors other than hinged side doors and back doors, as well as a new test procedure for assessing inertial forces.

[1] The sliding door test is conducted using two force application devices capable of applying a combined outward lateral force of 17,800 N (8,900 N each) at a constant rate of displacement of 5 mm per minute. Loads are applied to the door at its forward and aft edges.

The agency submitted a copy of the Preliminary Regulatory Evaluation “Door Latch Test Procedures FMVSS No 206” to the docket (19840-3). No comments were submitted to the docket on this document during the comment period.

While there are additional requirements in the Final Rule, this analysis will focus on three new test procedures and requirements for door latches that may have an impact on safety benefits or costs.

1. A sliding door test procedure and requirements
2. Secondary latch requirements for doors other than hinged side doors and back doors (essentially cargo doors or double-doors)
3. A new test procedure for assessing inertial forces as an alternative compliance option.

The general philosophy of this Final Rule is to improve test procedures for requirements that are already in place, or to harmonize with requirements that are already in place, and not to add new requirements. The agency could not at this time justify all the variety of tests that it has considered and researched for several reasons. First, we could not find a significant correlation for those test procedures with real crash data. Second, we did not know what countermeasures would be used to keep the doors closed in those tests.

1. Sliding door test procedure and requirements

Unlike most doors in FMVSS No. 206, sliding doors were regulated under the current standard as integrated systems. All sliding door retention components, including the door, track and slide combination, or other supporting means, may not separate when a total lateral force of 17,800 N (4,000 lb) is applied to the entire system with the door in the closed position. There was no requirement that the door have a primary latch system, or even a latch system with only a fully latched position. Rather, the entire door, with its door retention components, were tested. While vehicle manufacturers are required to certify compliance to this requirement, NHTSA had not conducted compliance tests on sliding doors because the standard did not have a test procedure for these doors. Transport Canada has developed a test procedure.

ECE regulations required that the sliding door systems be tested in a fully latched position and an intermediate latched position, if there is no intermediate position, when unlatched, the door must move into an apparent open position. The U.S and Canadian regulations had no latching system requirements for the sliding doors. The committee agreed it was appropriate to regulate the sliding side door latching system, but recognized that the existing ECE requirement to determine whether a sliding side door was unlatched was too subjective. Accordingly, the GTR specified that a door closure warning system would activate when the sliding side door is was not latched and there was no intermediate/secondary latching position. We are adopting this requirement in FMVSS No. 206 as well.

ECE R11 required that sliding doors have either a primary latch system that meets the same requirements as primary latch systems on hinged side doors, or a mechanism for determining when a sliding door is not fully latched. We are adopting a similar requirement. We are unaware of any sliding door designs that do not use some type of latch system. Rather than require sliding doors to be equipped with a primary latch system, we are allowing a latch system without a secondary latched position as long as the vehicle is equipped with a telltale that informs the driver of the vehicle that the door is not fully latched. We believe this approach will minimize the amount of redesign necessary to meet the new requirement, while assuring the driver that the sliding door is completely closed.

2. Secondary latch requirements for cargo doors

A "cargo-type door" is defined in FMVSS No. 206 as "a door designed primarily to accommodate cargo loading including, but not limited to, a two-part door that latches to itself." FMVSS No. 206 previously did not require cargo door latch systems to have a secondary latching system. ECE R11 already had a requirement for secondary latches. We are now adding a secondary latch requirement for cargo-doors to FMVSS No.206. These cargo doors will now be referred to as “double-doors” to clarify that the use of such doors is not limited to the stowage of cargo.

3. New test procedure for assessing inertial forces.

We are adding a dynamic inertial test procedure to FMVSS No. 206, as an option to the inertial calculation. The standard had a provision that manufacturers could certify to an agency approved test procedure. We are allowing the inertial test procedure to be optional in all instances. This will allow various compliance alternatives, such as conducting compliance testing the passenger cars and light trucks using the test procedure, while verifying compliance for retention systems on heavier vehicles using the long-standing formula. This approach recognizes the difficulty associated with the larger doors on these vehicles, while providing an objective means of testing that actually exerts forces upon the retention component.[2]

As in FMVSS No. 206, ECE R11 has a provision for an inertial loading test, but there is no specified test procedure. In the process of drafting the GTR, a test procedure was developed based on one type of testing currently conducted for ECE R11 type approval and validated by the US and Canada. This test procedure places inertial forces on doors, either when installed in the vehicle or when tested on a test buck, in the longitudinal and transverse directions.

This Final Regulatory Evaluation will discuss the anticipated costs and benefits of each of these three test requirements/procedures.

[2] During the drafting of the GTR, European manufacturers indicated that while they routinely relied on an inertial test procedure of some sort to gain type approval of their door retention systems, they still used the calculation contained in FMVSS No. 206 and ECE R11 because they needed the calculation to draft design specifications for these components.

II. Harmonization Efforts

There are several existing regulations, directives, and standards that pertain to door retention components. All share similarities, and the international motor vehicle safety community has tentatively determined that these components may be amenable to the development of a Global Technical Regulation (GTR) under the 1998 Global Agreement (1998 Agreement).

In developing language for a draft GTR, the members of the working group considered all relevant standards, regulations and directives. A preliminary analysis was made to identify the differences in the application, requirements, and test procedures of the North American and ECE R11 regulations (TRANS/WP.29/GRSP/2002/15).

The following regulations, directives and international voluntary standards were considered in drafting the GTR:

- UN/ECE Regulation 11 – Uniform provisions concerning the approval of vehicles with regard to door latches and door retention components.
- U.S Federal Motor Vehicle Safety Standard No.206, Door locks and door retention components. (FMVSS No. 206)
- EU Directive 70/387/EEC, concerning the doors of motor vehicles and their trailers.

- Canada Motor Vehicle Safety Regulation No. 206 – Door locks and door retention components. (CMVSS No. 206). [Note: The North American regulations FMVSS and CMVSS No. 206 are substantially similar].
- Japan Safety regulation for Road Vehicle Article 25 –
- Australian Design Rule 2/00 – Side Door Latches and Hinges
- SAE J839, September 1998 – Passenger Car Side Door Latch Systems
- SAE J934, September 1998 – Vehicle Passenger Door hinge Systems

The only significant differences between the sets of standards are found in FMVSS No. 206 and UN/ECE Regulation 11 (R11), before the rules were harmonized by the GTR in the new regulations. This is because the U.S. and Canadian standards mirrored each other, as the ECE and Japanese regulations mirrored each other. The Australian regulation had combined elements of both sets of regulations. And all regulations were largely based on SAE J839 and SAE J934.

III. Costs

There are three new test requirements:

1. A sliding door test procedure and requirements
2. Secondary latch requirements for doors other than hinged side doors and back doors (essentially cargo doors or double-doors)
3. A new optional test procedure for assessing inertial forces

Most of the cost discussion will focus on the sliding door test because it will have the most impact on vehicle costs. Testing costs will be discussed at the end of this chapter.

1. The sliding door test:

The new test procedure presses against the sliding door with two rams, near the front and rear of the sliding door, each at 9,000 Newtons, for a total load of 18,000 Newtons. While the load is being held, a gap is measured around the door and frame and the rule requires that this gap be no more than 100 millimeters (4 inches).

A significant factor in passing the appears to be whether the sliding door is attached using 2 latches or a latch on one side and a pin on the other side. Of the vehicles tested, it appears that only vehicles with 2 latches could pass the rule. None of the vehicles with a latch and a pin passed the test, failing always on the side with the pin.

The agency examined test data from Transport Canada and made a visual judgment about whether the 4-inch gap requirement was exceeded. In addition, the agency tested 5 vehicles and measured the 4-inch gap requirement. Table III-1 shows these test results. The test results indicate that every vehicle with 1 latch and a pin failed the 4-inch gap measurement, while all make/models that had 2 latches passed. In general, the test procedure that pushes on both ends of the door shows a weakness in the pin area that causes the doors with 1 latch and a pin to fail the test. Note that the same make/models were tested several times during different model years. While some of these make/models are several years old, the data indicate that there has not been a change in the pass/fail rates over the years for the same make/model indicating that there have not been significant (in terms of affecting the pass/fail rate) changes in the latch designs over the years and that the older test results appear valid.

Table III-1
Sliding Door Test Results

Transport Canada Test Results		Model	# of Latches	Pass/Fail 4" Gap
Model Year	Make			
1995	Dodge	Caravan	1	Fail
1998	Dodge	Caravan	1	Fail
2000	Mazda	MPV	1	Fail
1999	Honda	Odyssey	1	Fail
1997	Chevy	Venture	2	Pass
2000	Pontiac	Transport	2	Pass
1998	Ford	Windstar	2	Pass
1999	Ford	Windstar	2	Pass
NHTSA Test Results				
1993	Dodge	Caravan	1	Fail
2001	Dodge	Caravan	1	Fail
1992	Chevy	Lumina	1	Fail
2002	Honda	Odyssey	1	Fail
2001	Ford	Windstar	2	Pass

The agency used these test results, information on which make/models had one latch and which had two latches on the sliding door, which make/models now have one sliding door and which ones have two sliding doors, and component cost estimates to determine the estimated costs for the Final Rule. This information is presented in Table III-2.

Sliding Door Latch Costs

The agency does not have a teardown study of the costs of a sliding door latch. However, we do have teardown studies of the cost of a door latch on several vehicles. An April

2001 teardown study[3] stated that the "design configuration and material of the mounting plate, fork bolt and detent lever, are essentially the same as that found on some of the other latches…" referring to the Honda Odyssey sliding door latch compared to passenger cars and light truck door latches. Thus, we are assuming that the cost of a latch for a sliding door is similar to the cost of a latch for other vehicles. All cost estimates provided are consumer costs in year 2003 economics ($2003).

This April 2001 study found the latch cost of different vehicles were
95 Ford F150 $6.66
97 Ford Escort $4.62
95 Dodge Ram P/U $10.53

A 1978 teardown study of a F100 Pickup had the following costs
Door Latch Assembly - $5.54
Striker Assembly - $0.55
Rod - $0.52
Total = $6.61

A 1976 teardown of a MY 1975 Chevy Malibu had the following costs
Door Latch Assembly - $8.24
Striker Assembly - included
Rod - $0.66
Total = $8.90

In summary, based on the estimates above, the range of costs for a second latch for one sliding door are from $4.62 to $10.53. The average of the 5 different latches for which we have cost estimates is $7.46. This second latch will be replacing a pin. We don't have a teardown cost estimate for a pin, but if we assume it is somewhat less than a

[3] "Cost, Weight and Lead Time Analysis, FMVSS 206 Door Locks/Latches – Upgrade of Test Procedures", Final Report, Volume 1, Ludtke & Associates, April 30, 2001.

striker assembly, we could assume it costs around $0.46 and that the average incremental cost will be about $7.00 per latch.

The costs for mini-vans and large vans with sliding doors are presented in Table III-2. Note that there is a difference between the sales population and the number of sliding doors. In some cases, there are two doors for all models in the group, in other cases some models in the group have cargo doors and do not have sliding doors.

The agency based its cost estimates on the following assumptions:
Every vehicle with a one-latch system needed a second latch to comply.

We had no test data on the larger vans; however, all of them have 2 latches. We assumed that any large van, or any mini-van which had 2 latches, would pass the test and would not need an improvement to their latches.

Table III-2
Number of sliding doors and cost estimates

Mini Vans		**2003 Sales**	**# of Sliding Doors**	**Per Door Costs**	**Total Costs ($000's)**
Chevrolet	Astro	40,123	40,123	$7.00	$281
Chevrolet	Venture	94,521	189,042	$0	0
Chrysler	Voyager	20,333	40,666	$7.00	284
Chrysler	Town & Country	120,767	241,534	$7.00	1,691
Dodge	Caravan	233,394	400,000	$7.00	2,800
Ford	Freestar	15,771	31,542	$0	0
Ford	Windstar	113,465	113,465	$0	0
GMC	Safari	10,950	10,950	$7.00	76
Honda	Odyssey	154,063	308,126	$7.00	2,157
Kia	Sedona	50,628	101,256	$7.00	709
Mazda	MPV	30,689	61,378	$7.00	430
Mercury	Monterey	2,213	4,426	$0	0
Nissan	Quest	23,170	46,340	$0	0
Oldsmobile	Silhouette	14,772	29,544	$0	0
Pontiac	Montana	39,588	79,176	$0	0
Toyota	Sienna	105,499	210,998	$0	0
Total Mini Vans		1,069,946	1,908,566		$8,428
Large Vans					
Chevrolet	Express	104,734	35,000	$0	0
GMC	Savana	34,370	15,000	$0	0
Dodge	Sprinter Van	1,941	3,000	$0	0
Ford	Econoline	161,721	50,000	$0	0
Total Large Vans		302,766	103,000		0
Total		1,372,712	2,011,566		$8,428
Subtotals	One Latch	660,947	1,204,033		$8,428
	Two Latches	711,765	807,533		

In summary, there were almost 1.4 million vans sold in 2003 that had a little more than 2 million sliding doors.

An estimated 52 percent of the vans and 40 percent of the doors already comply,

An estimated 660,000 vans (48%) with 1.2 million doors (60%) need a second latch to comply.

The total costs for the sliding door Final Rule are about $8.4 million annually.

The April 2001 Ludtke teardown study of the costs of the new standard for FMVSS No. 206 found that the mounting plate could be improved to strengthen the latch. This is not necessary for doors with two latches to meet the Final Rule. However, it is something that the manufacturers might consider for future latch designs. The incremental costs for improving the mounting plate was $0.18 per latch, but was not added to the cost of the Final Rule.

2. Secondary latch requirements for cargo doors or double doors

The agency estimates that the cost of adding a secondary latch position for cargo doors or double doors would be very small. We examined one of the three large van make/models that had cargo doors. It had a secondary latch position.

3. A new test procedure for assessing inertial forces

The inertial test is optional for the manufacturers. Thus, there are no vehicle costs.

Testing Costs

1. We estimate that the sliding door test would cost about $1,300 to run for one door or $1,950 for both doors per make/model. However, since most sliding doors are fairly symmetrical, it is likely that only one door would need to be tested. In addition, a vehicle is needed for the test, which would average about $25,000 for a van. There is also a one-time cost for the test equipment (e.g. hydraulic pumps), fabrication and assembly time needed, which we estimate will cost about $5,000. This test equipment would then be used for every test thereafter.
2. New optional test for inertial forces. The agency is considering options for running the inertial force test. Possibly a sled buck would be set up with two sets of doors oriented perpendicular to each other and the sled run twice to test the doors in both the positive and negative longitudinal and transverse directions. It would cost about $2,500 to set the sled buck up and another $2,500 to run each sled test. Additionally, 4 doors would be needed for the test, which might cost $800 a piece. The lowest total test cost per vehicle would be $10,700 for a 2-door vehicle with no back door ($2,500 + 2 test runs*$2,500 + 4 doors *$800). The highest total test cost per vehicle would be $27,100 for a 4-door vehicle with a back door and non-symmetrical front and rear side doors requiring 6 sled tests and 12 doors ($2,500 + 6*$2,500 + 12*$800).

Leadtime

The new requirements will become effective on September 1, 2009.

IV. Benefits

Of the three test procedures, we can only estimate the benefits of the new test procedure for sliding doors. There may be benefits from testing with the inertial test, however this is an option for manufacturers and we have not developed a method of estimating benefits for the inertial test. We believe the manufacturers already meet the other requirements and thus there will be no incremental benefits for them.

Target Population

Tables IV-1 and IV-2 present an overview of the door ejection problem based on 1995-2003 NASS and FARS, from towed light vehicle (passenger cars, pickups, vans, and SUVs) crashes adjusted for fatality and damage area. With over 5 million vehicle occupants in tow-away crashes, over 54,000 were ejected and of those 7,622 were ejected through doors. If you distributed the unknown ejection routes, there would be an annual average of 8,082 ejections through doors, about 15 percent of all ejections. As shown in Table IV-2, the ejection rates in rollovers are much higher than the ejection rates in non-rollovers, 17 times higher for all ejections (7.62%/0.44%) and 7.5 times higher for door ejections (0.75%/0.10%).

Table IV-1
Light Vehicle Occupants
Overall Ejection Statistics on an Annual Basis

All occupants	Door Ejections	Side Glazing Ejections	Ejections with Other Known Routes	Ejections with Unknown Routes	Total Ejections
All crashes 5,023,879	7,622 (14%)	29,877 (55%)	13,505 (25%)	3,078 (6%)	54,082 (100%)
Rollovers 444,267	3,089	19,098	9,261	2,399	33,847
Non-Rollovers 4,579,612	4,533	10,779	4,243	680	20,235

Table IV-2
Light Vehicle Occupants
Ejection Rates with Unknown Ejection Routes Distributed*
(%)

	Door Ejections	Side Glazing Ejections	Other Known Ejection Routes	Total Ejections
Given a Rollover, the Ejection Rates Are	0.75%	4.63%	2.24%	7.62%
Given a Non-Rollovers, the Ejection Rates Are	0.10%	0.24%	0.10%	0.44%

* Calculated by taking total ejections/total occupants times the number of ejections of a given route/the number of total ejections with known ejection routes. For example, for door ejections in a rollover, 33,847/444,267*3,089/(33,847-2,399).

Based on an analysis of the same 1995 to 2003 NASS-CDS and FARS data, Table IV-3 presents an annual average of the number of injuries and fatalities that occurred as a result of ejections through sliding doors. During this time frame there were only 8[4] ejected occupants through sliding doors in our sample, 5 injuries and 3 fatalities. On an annual basis, these cases when weighted up to a national average result in 30 injuries and 20 fatalities. These data were examined by make/model to determine how many were with one latch and a pin and those make/models with two latches. All of the injuries and fatalities were from models that had one latch and a pin. All of these vehicles were minivans. Just because there were no ejection injuries in our sample through sliding doors with 2 latches or through sliding doors on large vans, does not mean that there are no ejection injuries occurring in the nation. As proof of this, Table IV-4 shows door openings for minivans with two latches in the NASS. There just happened to be no occupants ejected out those doors when they opened.

[4] The year-psu-case#-vehicle-occupant number-make/model for the 8 cases are: 1995-73-153-1-2-1991Chevy Astro Van, 1998-79-58-1-1-1986 Dodge Caravan, 1999-12-43-1-1-1993 Plymouth Voyager, 2001-78-124-1-3 Ford Aerostar, 2001-81-128-2-3 1995 Dodge Caravan, 2002-78-6-1-2 1997 Ford Aerostar, 2002-78-6-1-4 1997 Ford Aerostar, 2003-78-73-1-5 1991 Ford Aerostar.

Table IV-3
Target Population of Ejections Through Sliding Doors

Doors with One Latch and a Pin	Unweighted Number of Ejected Occupants	Weighted Number of Injuries or Fatalities
AIS 1	0	0
AIS 2	1	7
AIS 3	2	7
AIS 4	2	16
AIS 5	0	
Total Non-fatal Injuries	5	30
Fatalities	3	20
Doors with Two Latches	No cases	0

Effectiveness

In order to examine the effectiveness of doors with two latches versus doors with one latch and a pin, the agency developed exposure data from the same 1995 to 2003 NASS-CDS and FARS weighted data. We took all minivans with sliding doors in the data and divided them into those with 2 latches and those with 1 latch and a pin. Then we compared the door opening rate for those with 2 latches and those with 1 latch and a pin. The door opening rate is defined as the number of door openings versus the number of sliding doors. For those mini-vans with 2 sliding doors, both doors were included in the denominator of the equation.

Table IV-4
Effectiveness of Two Latches in Reducing Door Openings in Minivans

Latch type	Sliding Door Openings	Annual Average number of vehicles in 95-03 CDS with sliding doors	Annual Average number of sliding doors in 95-03 CDS	Sliding Door Openings/ Number of Sliding Doors
One latch and a pin	1,096	124,603	151,598	0.00723
Two latches	48	15,142	26,574	0.00181
Effectiveness				75%

The results of this analysis are that adding a second latch to a minivan sliding door that currently has one latch and a pin, would reduce the door openings by 75 percent. Thus, the effectiveness of doors with two latches versus doors with one latch and a pin is 75 percent. Appendix A presents a statistical analysis showing that this effectiveness is statistically significant and that the 95% confidence interval is 21% to 92%.

We assume that the effectiveness for door openings, will be applicable to ejections and the same effectiveness estimates will be assumed for both injuries and fatalities.

Estimated Benefits

In order to estimate the benefits from adding a second latch to sliding doors, three sets of calculations are needed. First, we need to adjust the target population estimate to take into account that the target population discussed above in Table IV-4 had a distribution of 85 percent with a one-latch system and 15 percent with a two-latch system, while the

2003 baseline of vehicles in Table III-2 has a distribution of 60 percent with a one-latch system and 40 percent with a two-latch system.

Using the door opening rates from Table IV-4, the adjustment would be:

.85*.723 + .15*.181 = .6417

.60*.723 + .40*.181 = .5062

.5062/.6417 * 50 = 39.

This means that the current 2003 distribution of latches would have resulted in 39 ejections rather than the 50 ejections found in the data base of 1995-2003 NASS-CDS, since there are a higher percentage of the more effective two-latch systems in the 2003 new fleet of vehicles.

The second adjustment necessary is to determine the potential ejection fatalities and injuries assuming all vehicles had a one-latch system. Then we can determine the benefits of the current fleet of vehicles and the incremental benefits for the future fleet with two-latches.

With the revised estimate of 39 the formula for determining the number of ejections that would have occurred if all of these vehicles had just one latch is

Number of ejections/(1-usage*effectiveness) = 39/(1-.40*.75) = 56.

Thus, there would be 56 ejections if every sliding door had one-latch. The benefits are then 56*.75 = 42 minus the current benefits of 40 percent of the fleet already having two-latches 56*.75*.40 = 17. Thus, the incremental benefits would be a reduction of 25 ejections through sliding doors.

When an occupant is retained in a vehicle and the ejection is eliminated, it does not necessarily mean that the occupant escapes uninjured. The third calculation necessary to estimate benefits is to estimate the remaining injury that would occur to the occupant given that they are retained within the vehicle. Based on a NHTSA study[5], the elimination of ejection for an unrestrained occupant would reduce fatalities by 68 to 72 percent, and incapacitating injuries (A injuries in the police reported KABCO system) by 49 to 58 percent. These fatalities and serious injuries prevented were redistributed to lesser severity injuries to derive the injury profile with ejection prevented. The techniques of redistribution and KABCO to AIS conversion are described in the NHTSA's technical report on advance glazing[6]. The results are shown in Table IV-5

[5] Winnicki, J., "Estimating the Injury-Reducing Benefits of Ejection-Mitigating Glazing", DOT HS 808 369, February, 1996

[6] Willke, D., et al, "Ejection Mitigation Using Advanced Glazing, Status Report II", August, 1999. We used the case at 80 percent belt use rate.

Table IV-5
Estimated Safety Benefits for
Ejection Prevention Through Sliding Doors

	Ejection Injury Profile	Injury Profile With Ejection Prevented	Incremental Safety Benefits
AIS 1	0	10	-10
AIS 2	3	3	0
AIS 3	4	3	1
AIS 4	8	5	3
AIS 5	0	0	0
Fatalities	10	3	7

Thus, the incremental benefits from this requirement are estimated to be a reduction of 7 fatalities, 3 AIS 4 injuries, and 1 AIS 3 injury, and an increase of 10 AIS 1 injuries.

V. Cost Effectiveness and Benefit-Cost Analyses

A. Costs Effectiveness Analysis

This section combines costs and benefits to provide a comparison of the estimated injuries and lives saved with costs. Vehicle costs occur when the vehicle is purchased, but the safety benefits accrue over the lifetime of the vehicle. Safety benefits must therefore be discounted to express their present value and put them on a common basis with vehicle costs.

In some instances, costs may exceed economic benefits, and in these cases, it is necessary to derive a net cost per equivalent fatality prevented. An equivalent fatality is defined as the sum of: (1) fatalities and (2) nonfatal injuries prevented converted into fatality equivalents. This conversion is accomplished using the relative values of fatalities and injuries measured using a "willingness to pay" approach. This approach measures individuals' willingness to pay to avoid the risk of death or injury based on societal behavioral measures, such as pay differentials for more risky jobs.

Table V-1 presents the relative estimated rational investment level to prevent one injury, by maximum injury severity. Thus, one MAIS 1 injury is equivalent to 0.0031 fatalities. The data represent average costs for crash victims of all ages. The Abbreviated Injury Scale (AIS) is an anatomically based system that classifies individual injuries by body region on a six point ordinal scale of risk to life. The AIS does not assess the combined effects of multiple injuries. The maximum AIS (MAIS) is the highest single AIS code for an occupant with multiple injuries.

Table V-1

Comprehensive Fatality and Injury Relative Values	
Injury Severity	2000 Relative Value* per injury
MAIS 1	.0031
MAIS 2	.0458
MAIS 3	.0916
MAIS 4	.2153
MAIS 5	.7124
Fatals	1.000
* includes the economic cost components and valuation for reduced quality of life	

Source: "The Economic Impact of Motor Vehicle Crashes, 2000", NHTSA, May 2002, DOT HS 809 446.

Table V-2 shows the estimated equivalent fatalities. The injuries are weighted by the corresponding values in Table V-1, added to the fatalities, and then summed.

Table V-2
Equivalent Fatalities (Undiscounted)

FATALITY BENEFITS	INJURY BENEFITS	EQUIVALENT FATALITIES
7	**0.7**	**7.7**

Appendix V of the "Regulatory Program of the United States Government", April 1, 1990 - March 31, 1991, sets out guidance for regulatory impact analyses. One of the guidelines deals with discounting the monetary values of benefits and costs occurring in different years to their present value so that they are comparable. The agency will perform a cost-effectiveness analysis resulting in an estimate of the cost per equivalent life saved. The guidelines state, "An attempt should be made to quantify all potential real incremental benefits to society in monetary terms of the maximum extent possible." For the purposes of the cost-effectiveness analysis, the Office of Management and Budget (OMB) has requested that the agency compound costs or discount the benefits to account for the different points in time that they occur.

There is general agreement within the economic community that the appropriate basis for determining discount rates is the marginal opportunity costs of lost or displaced funds. When these funds involve capital investment, the marginal, real rate of return on capital must be considered. However, when these funds represent lost consumption, the appropriate measure is the rate at which society is willing to trade-off future for current consumption. This is referred to as the "social rate of time preference," and it is generally assumed that the consumption rate of interest, i.e. the real, after-tax rate of return on widely available savings instruments or investment opportunities, is the appropriate measure of its value.

Estimates of the social rate of time preference have been made by a number of authors. Robert Lind[7] estimated that the social rate of time preference is between zero and 6 percent, reflecting the rates of return on Treasury bills and stock market portfolios. Kolb and Sheraga[8] put the rate at between one and five percent, based on returns to stocks and three-month Treasury bills. Moore and Viscusi[9] calculated a two percent real time rate of time preference for health, which they characterize as being consistent with financial market rates for the period covered by their study. Moore and Viscusi's estimate was derived by estimating the implicit discount rate for deferred health benefits exhibited by workers in their choice of job risk.

OMB Circular A-4 recommends agencies use both 3 percent and 7 percent as the "social rate of time preference".

Safety benefits can occur at any time during the vehicle's lifetime. For this analysis, the agency assumes that the distribution of weighted yearly vehicle miles traveled are appropriate proxy measures for the distribution of such crashes over the vehicle's lifetime. Multiplying the percent of a vehicle's total lifetime mileage that occurs in each

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[7]Lind, R.C., "A Primer on the Major Issues Relating to the Discount Rate for Evaluating National Energy Options," in Discounting for Time and Risks in Energy Policy, 1982, (Washington, D.C., Resources for the Future, Inc.).

[8]J. Kolb and J.D. Sheraga, "A Suggested Approach for Discounting the Benefits and Costs of Environmental Regulations,: unpublished working papers.

[9]Moore, M.J. and Viscusi, W.K., "Discounting Environmental Health Risks: New Evidence and Policy Implications," Journal of Environmental Economics and Management, V. 18, No. 2, March 1990, part 2 of 2.

year by the discount factor and summing these percentages over the 25 years of the average light truck vehicle's operating life, results in multipliers of 0.8054 at a 3 percent discount rate and 0.6315 at a 7 percent discount rate for light trucks. These values are multiplied by the equivalent lives saved to determine their present value (e.g., at 3%, 10 x .8054 = 8). The costs per equivalent life saved for vans with sliding doors are then computed and shown in Table V-4.

Table V-3

Discounting of Equivalent Lives Saved

Base Equivalent	3 Percent	7 Percent
7.7	6.2	4.9

Table V-4
Costs per Discounted Equivalent Life Saved
($ millions)

Costs	Costs per Equivalent Life Saved @ 3 Percent	Costs per Equivalent Life Saved @ 7 Percent
$8.4 mill.	$1.35 mill.	$1.71 mill.

B. Benefit-Cost Analysis

Effective January 1, 2004, OMB Circular A-4 requires that analyses performed in support of proposed rules must include both cost effectiveness and benefit-cost analysis. Benefit-cost analysis differs from cost effectiveness analysis in that it requires that benefits be assigned a monetary value, and that this value be compared to the monetary value of costs to derive a net benefit. In valuing reductions in premature fatalities, we used a value of $3.5 million per statistical life. The most recent study relating to the cost of crashes published by NHTSA[10], as well as the most current DOT guidance on valuing fatalities[11], indicate a value consistent with $3.5 million. This value represents an updated version of a meta-analysis of studies that were conducted prior to 1993. More recent studies indicate that higher values may be justified.[12]

When accounting for the benefits of safety measures, cost savings not included in value of life measurements must also be accounted for. Value of life measurements inherently include a value for lost quality of life plus a valuation of lost material consumption that is represented by measuring consumers after-tax lost productivity. In addition to these factors, preventing a motor vehicle fatality will reduce costs for medical care, emergency

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[10] L. Blincoe, A. Seay, E. Zaloshnja, T. Miller, E. Romano, S. Luchter, R. Spicer, (May 2002) "The Economic Impact of Motor Vehicle Crashes, 2000". Washington D.C.: National Highway Traffic Safety Administration, DOT HS 809 446.

[11] "Revised Departmental Guidance, Treatment of Value of Life and Injuries in Preparing Regulatory Evaluations", Memorandum from Kirk K. Van Tine, General Counsel and Linda Lawson, Acting Deputy Assistant Secretary for Transportation Policy to Assistant Secretaries and Modal Administrators, January 29, 2002.

[12] For example, Miller, T.R. (2000): "Variations Between Countries in Values of Statistical Life", Journal of Transport Economics and Policy, 34, 169-188.

services, insurance administrative costs, workplace costs, and legal costs. If the countermeasure is one that also prevents a crash from occurring, property damage and travel delay would be prevented as well. The sum of both value of life and economic cost impacts is referred to as the comprehensive cost savings from reducing fatalities.

The 2002 NHTSA report cited above estimates that the comprehensive cost savings from a crash-worthiness countermeasure was \$3,346,967 in 2000 economics. This estimate is adjusted for inflation to the 2003 cost level used in this report. Based on the CPI ALL Items index (184.0/172.2), this would become \$3,576,318. NHTSA has decided to keep the basis for the benefit-cost analyses at this time at \$3.5 million.

Total benefits from injuries and fatalities reduced are derived by multiplying the value of life by the equivalent lives saved. The benefit-costs are derived by subtracting the total costs from the total benefits, as shown in Table V-5. Positive Benefits indicate that Benefits valued at \$3.5 million per equivalent life are higher than Costs. Negative Benefits indicate that Benefits valued at \$3.5 million per equivalent life are lower than Costs.

Table V-5
Net Benefits with a Value of $3.5M per Statistical Life
(Millions of 2003 Dollars)

3% Discount Rate	7% Discount Rate
$13.3 Mil.	$8.8 Mil.

VI. Small Business Impacts

A. Regulatory Flexibility Act

The Regulatory Flexibility Act of 1980 (5 U.S.C. §601 et seq.) requires agencies to evaluate the potential effects of their proposed and final rules on small businesses, small organizations and small governmental jurisdictions.

Small Vehicle Manufacturers

Currently, there are about 4 small motor vehicle manufacturers in the United States[13]. None of these manufacturers make vehicles with sliding doors. Thus, the only additional expense of this Final Rule would be the new test in a side impact test. With a cost estimate for testing of $1,500, the agency does not believe this will create a significant economic burden for these manufacturers.

There are a few recreational vehicles made which are less than 10,000 pounds GVWR, which would have to comply with the standard. Recreational vehicles typically do not use sliding doors, so there should be very little impact of this proposal on them. Most of the vehicles that use van chassis supplied by the larger manufacturers (GM, Ford, or Daimler Chrysler) do not use sliding doors in their vehicles.

Van converters use sliding doors usually do not alter the doors or areas that could be impacted by the sliding door test. In this case, a van converter would primarily rely upon the chassis manufacturer's certification. One exception to this rule could be van converters, who install a lift system for a handicapped person. Most van converters do

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[13] Avanti, Callaway, Panoz, and Saleen.

not modify the door latch system, but when they do, they must provide their own certification.

In conclusion, the agency believes that this Final Rule will not have a significant economic impact on a substantial number of small businesses.

B. Unfunded Mandates Reform Act

The Unfunded Mandates Reform Act of 1995 (Public Law 104-4) requires agencies to prepare a written assessment of the costs, benefits, and other effects of proposed or final rules that include a Federal mandate likely to result in the expenditures by State, local or tribal governments, in the aggregate, or by the private sector, of more than $100 million annually (adjusted annually for inflation with base year of 1995). Adjusting this amount by the implicit gross domestic product price deflator for the year 2003 results in $116 million (114.12/98.11 = 1.16). The assessment may be included in conjunction with other assessments, as it is here.

The Final Rule is not likely to result in expenditures by State, local or tribal governments of more than $116 million annually. Nor, is it likely to result in the expenditure by automobile manufacturers and/or their suppliers of more than $116 million annually. The agency has estimated that compliance with this final rule would cost $8.4 million.

Appendix A

95% CONFIDENCE LIMITS FOR THE EFFECTIVENESS $\hat{E}$

CONTINGENCY TABLE

Frequencies given in Table A-1 were used in computing all the subsequent estimates and their 95% confidence intervals.

TABLE A-1

Number Of Latches	Unadjusted		Adjusted	
	Rear Doors	Rear Doors Opened	Rear Doors	Rear Doors Opened
	Number	Number	Number	Number
1	110,158	794	151,598	1,096
2	19,312	35	26,574	48

RATIOS AND THEIR STANDARD ERRORS

RATIO procedure of the software SUDAAN was used to compute ratios and their standard errors for the adjusted and unadjusted cases. Estimates of ratios and their standard errors are presented in Table A-2.

TABLE A-2

Number Of Latches	Ratio			
	Unadjusted		Adjusted	
	Estimate	S.E.	Estimate	S.E.
1	$\hat{R}_1 = 0.00721$	0.00236	$\hat{R}_1 = 0.00723$	0.00236
2	$\hat{R}_2 = 0.00181$	0.00088	$\hat{R}_2 = 0.00181$	0.00089

EFFECTIVENESS AND ITS 95% CONFIDENCE LIMITS

Effectiveness is calculated using the formula:

$$\hat{E} = 1 - \frac{\hat{R}_2}{\hat{R}1} \qquad (1),$$

where values of $\hat{R}_1$ and $\hat{R}_2$ for adjusted and unadjusted cases are used from Table A-2. Using linearization procedure [1,2], the 95% confidence limits for effectiveness, $\hat{E}$ [equation(1)], are given by

$$1 - e^{\left\{ \ln\left(\frac{\hat{R}_2}{\hat{R}_1}\right) \pm 1.96 * \mathrm{SE}\left(\frac{\hat{R}_2}{\hat{R}_1}\right) \right\}} \qquad (2),$$

$$\mathrm{SE}\left(\frac{\hat{R}_2}{\hat{R}_1}\right) = \left\{ \frac{1}{\hat{R}_1^2} \mathrm{Var}(\hat{R}_1) + \frac{1}{\hat{R}_2^2} \mathrm{Var}(\hat{R}_2) \right\}^{1/2} \qquad (3)$$

Using estimates obtained in Table A-2, the following estimates of the effectiveness, the lower confidence limit, and upper confidence limit were obtained from the formulas (1), (2), and (3). These estimates are presented in Table A-3.

TABLE A-3

CASE	EFFECTIVENESS		
	$\hat{E}$	Lower 95% Limit	Upper 95% Limit
UNADJUSTED:	75%	21%	92%
ADJUSTED	75%	21%	92%

REFERENCES

[1] *Sudaan User Manual*, Release 8.0, Research Triangle Institute, 2001.

[2] W. G. Cochran, *Sampling Techniques*, 3rd edition. John Wiley & Sons, Inc. New York. 1977.